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**Title:** Synoptic/Planetary-Scale Interactions and Blocking over the North Atlantic Ocean

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### **Significant Accomplishments in the Past Year:**

Work was completed on the height tendency diagnoses of two extratropical cyclones that occurred upstream from the blocking event studied previously. One developed explosively over water 60 to 36 hours before the block first appeared, while the second developed explosively over the southeastern United States during the time of block formation. In both cases, both vorticity and temperature advection were consistently important forcing mechanisms. This is in contrast to the block itself, in which vorticity advection was easily the dominant forcing mechanism. Latent heat release was also significant, accounting for about 50% of the total height falls in the cyclone below 850 mb. Estimates of latent heat release were greatly enhanced by coupling parameterized estimates with values derived from GOES IR data using an algorithm developed by Marshall's F.R. Robertson.

Among the difficulties encountered in this work was the identification of an appropriate lower boundary condition for the solution of the height tendency equation. The zero value currently used tends to yield underestimates of the lower troposphere height tendencies. To address this problem a new diagnostic technique was developed in cooperation with Dr. Peter Zwack of the University of Quebec at Montreal. Based on an equation Dr. Zwack had previously developed (the Zwack-Okossi development equation), we now have a relationship that is completely consistent with the height tendency equation and provides estimates of lower boundary geostrophic vorticity or height tendencies.

Finally, comparison of the SAT and NOSAT analyses is progressing well. Basic fields from the two analyses are very similar (correlation coefficients typically greater than 0.95), while higher order derived parameters (e.g., terms in the height tendency equation) sometimes exhibit correlations less than 0.90.

### **Focus of Current Research and Plans for Next Year:**

The present focus is on both the new diagnostic technique and the SAT/NOSAT comparisons. The former is being tested on the southeastern United States cyclone case previously mentioned and compared with the height tendency

diagnoses already completed. The latter are being examined for the blocking case described in the publications cited in this summary. In addition to obtaining statistics that will allow general comparison of the two analyses, it will be possible to determine whether conclusions about the dynamics of the block development are influenced by the analysis set used.

### Publications:

#### 1. Refereed:

- a. Tsou, C.-H., and P.J. Smith (1990): The Role of Synoptic/ Planetary-Scale Interactions During the Development of a Blocking Anticyclone. Tellus, 42A, 174-193.
- b. \_\_\_\_\_, and \_\_\_\_\_ (1990): The Importance of Non-Quasigeostrophic Forcing During the Development of a Blocking anticyclone. Tellus, 42A, 328-342.

#### 2. Non-refereed:

Fosdick, E.K., and P.J. Smith: Latent Heating Associated With a Rapidly Developing Cyclone Over the North Atlantic Ocean. Preprints of the 12th Conference on Weather Analysis and Forecasting, October 2-6, 1989, Monterey, CA.

#### 3. Presented papers

Both papers presented at the Fifth Scientific Assembly of IAMAP, July 31 - August 12, 1989, Reading, United Kingdom.

Smith, P.J., and C.-H. Tsou: The Importance of Non-Quasigeostrophic Forcing During the Development of a Blocking Anticyclone.

Smith, P.J., and M.A. Uhl: A Diagnosis of a Rapidly Developing Winter Cyclone Over the North Atlantic Ocean.

#### 4. Theses

##### a. M.S.

Fosdick, E.K.: The Role of Latent Heating in the Explosive Development of Two Extratropical Cyclones (August, 1989).

Uhl, M.A.: Synoptic-Scale Forcing of Two Explosively Developing Cyclones (December, 1989).

##### b. Undergraduate Honors

Knabb, R.D.: The Role of Vorticity in an Explosively Deepening Extratropical Cyclone (May, 1990).